

## A peculiar evolutive lineage of the uncus in the genus *Catada* Walker, [1859] 1858

(Lepidoptera, Noctuidae, Hypeninae)

Martin Lödl

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A distinct and aberrant lineage of unci within the genus *Catada* Walker, [1859] 1858 is discussed as one of the rare examples of a continuous documentation of the evolutive development from plesiomorphic to apomorphic features. A brief description of the genitalic features of the genus is given. The phylogeny of the major part of the species set of the genus is presented.

Dr. Martin Lödl, Naturhistorisches Museum Wien, 2. Zoologische Abteilung, Burgring 7, A-1014 Wien, Austria. e-mail: martin.loedl@nhm-wien.ac.at

### Introduction

The genus *Catada* was described by Walker in [1859] 1858 based on the species *Catada glomeralis* Walker, [1859] 1858 in the family “Herminidae”. This species was described in the same publication on a previous page as *Bocana vagalis* Walker, [1859] 1858. Both taxa are coming from Sri Lanka.

The exact systematic position of *Catada* remains unclear, although it is traditionally placed in the Hypeninae. A redescription and illustration of the type species of the genus *Catada* and a commented list of species based on Poole (1989) were given in Lödl (1999b). Derived African species have been reported in Lödl (2000). The relationship to the genus *Nolasena* Walker, [1858] 1857 is also under discussion (Lödl 1999a).

The male genitalia of *Catada* can be characterised with the following punctuation (Fig. 14):

- The uncus region is complex, consisting of an aberrant uncus and a claw like scaphium of the anal cone.
- The tegumen is slim and slender, forming a swelling from the ventral side.
- The anellus is a skinny glove covered with spines.
- The valves are skinny and divided into two big lobes at the distal end or simple and wear a bristle covered lobe in the middle, protruding in the lumen of the genital corpus.
- The sacculus is well developed and forms a giant, flabby eversible tube (coremata!), which is densely covered with very long hair-like scales. There are three centres of density of hairs: one ventrally at the base, covered with the longest hairs, one on the dorsal margin in the distal third and one at the distal tip.
- The vinculum is insignificant, rounded and is not exceeding the length of the remaining genitalia corpus proximally.
- The aedeagus is a slender, more or less straight tube with a blunt distal end.

## Material and Methods

This study was carried out with conventionally dried specimens from the collections of The Natural History Museum (BMNH) in London, the Naturhistorisches Museum Wien (NHMW) and the Muséum national d'Histoire Naturelle (MNHN) in Paris. Genitalia preparations have been made in the traditional way (maceration by use of KOH, preparation and isolation of the genitalia tract). The genitalia have been stained with Chlorazol Black.

The SEM investigations were carried out by using conventionally prepared specimens (alcohol and as a final stage 99,9 % cooled acetone), coated with gold, on a Jeol 6000/400.

### List of species investigated

Base of the investigation is a set of *Catada*-species (type locality in square brackets; deposit of types in normal brackets):

- Catada antevorta* (Viette, 1958) [Madagascar] (MNHN)
- Catada canaliferalis* (Moore, 1877) [Andaman Islands] (BMNH)
- Catada charalis* Swinhoe, 1900 [Australia, Queensland] (BMNH)
- Catada ndalla* Bethune-Baker, 1911 [Angola] (BMNH)
- Catada obscura* Joannis, 1906 [Mauritius] (BMNH)
- Catada phaeopasta* Hampson, 1909 [Uganda, Ruwenzori] (BMNH)
- Catada renalis* (Moore, 1882) [India, Khasia Hills] (BMNH)
- Catada transversalis* (Moore, 1877) [Andaman Islands] (BMNH)
- Catada vagalis* (Walker, [1859] 1858) [Sri Lanka] (BMNH)

The type specimens of the species have been examined.

The SEM investigation is based on:

*Hypena variabilis* Walker, [1866] 1865 [Sierra Leone] (NHMW) (SEM study)

## Abbreviations

BMNH	The Natural History Museum, London
MNHN	Museum National d'Histoire Naturelle, Paris
NHMW	Naturhistorisches Museum, Wien
sc	scaphium
scl	length of scaphium
ta	tuba analis
te	tegumen
u	uncus

## Results

Normally the decision if the state of a feature of the copulatory system is plesiomorphic or apomorphic is a very delicate one. A typical hook-shaped uncus as it is found in the genus *Hypena* Schrank, 1802 is illustrated in fig. 1. The transformation of the uncus from hook shaped to aberrantly helmet shaped with a lace of sclerotized teeth within the genus *Catada* is documented in this paper. The hook shaped state of the uncus in the African species *Catada phaeopasta* Hampson, 1909 is clearly the plesiomorphic condition (Figs 2-5).

The transformation of this character follows three steps:

1. A big uncus with two rounded knees, hook shaped with several sclerotized teeth-like setae on the ventrolateral middle of the uncus. The uncus tip also with some sclerotized teeth. The dorsal margin is poor in hair-like scales (Figs 2-5).
2. A more or less rounded uncus with a flattened distal part. Two areas of teeth-like setae are found. One is formed like a tonsure at the distolateral part of the uncus, one is formed as a row of setae situated ventrolaterally. The hair-like scales of the dorsal margin are confined to the distal part of the uncus (Figs 6-7, 15).

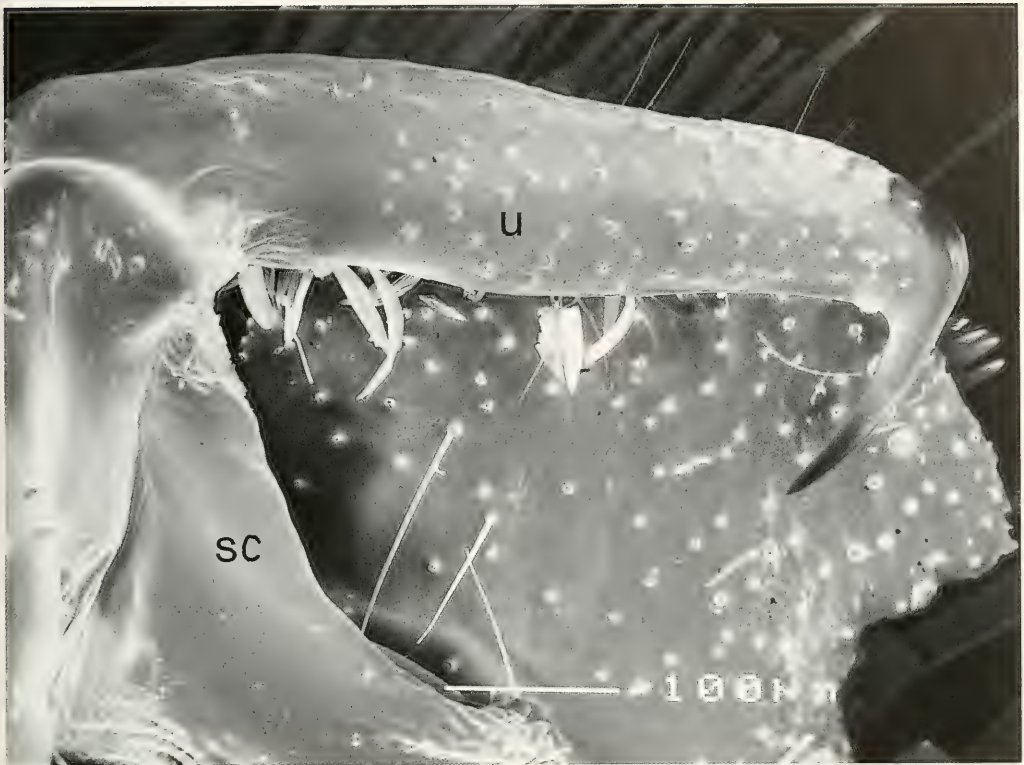


Fig. 1. Uncus-scapium-device in *Hypena variabilis* Walker, [1866] 1865; SEM. – sc scaphium; u uncus.

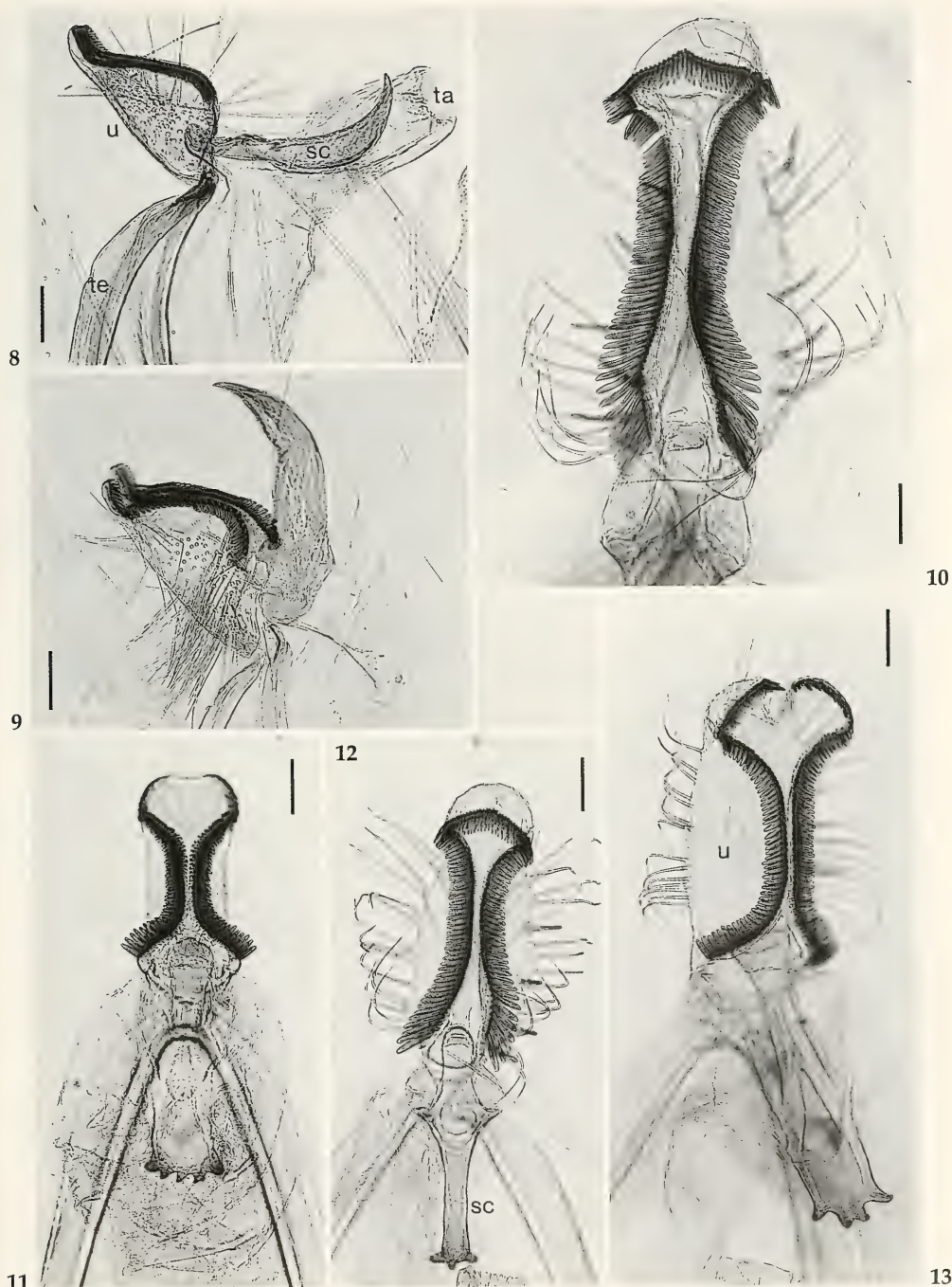
3. Completely aberrant uncus, like a helmet with a slim and rounded distal part and a blown up basal part. Both setae areas are linked together to a lace of sclerotized teeth forming a trimming along the ventrolateral margin of the uncus. The dorsal margin is rich in hair-like scales (Figs 8-13).

There is a clear lineage from the plesiomorphic state “hook-shaped” uncus to an extraordinarily aberrant “helmet-shaped” uncus. The feature “lace of teeth-like setae” is starting with a few small teeth in the most primitive form: *C. phaeopasta*, *C. transversalis* and *C. antevorta* (Viette, 1958) represent a clear intermediate with three separated areas of teeth-like setae on the uncus. One field at the distal area and two fields at both ventrolateral margins. The mostly evolved species show a completed lace of strong teeth-like setae. This lace strictly follows the ventrolateral margin of the uncus and forms a distinct bend at the distal end of the helmet. A phylogeny of the involved *Catada*-species – mainly based on characters of the male copulatory system – is given in fig. 16.

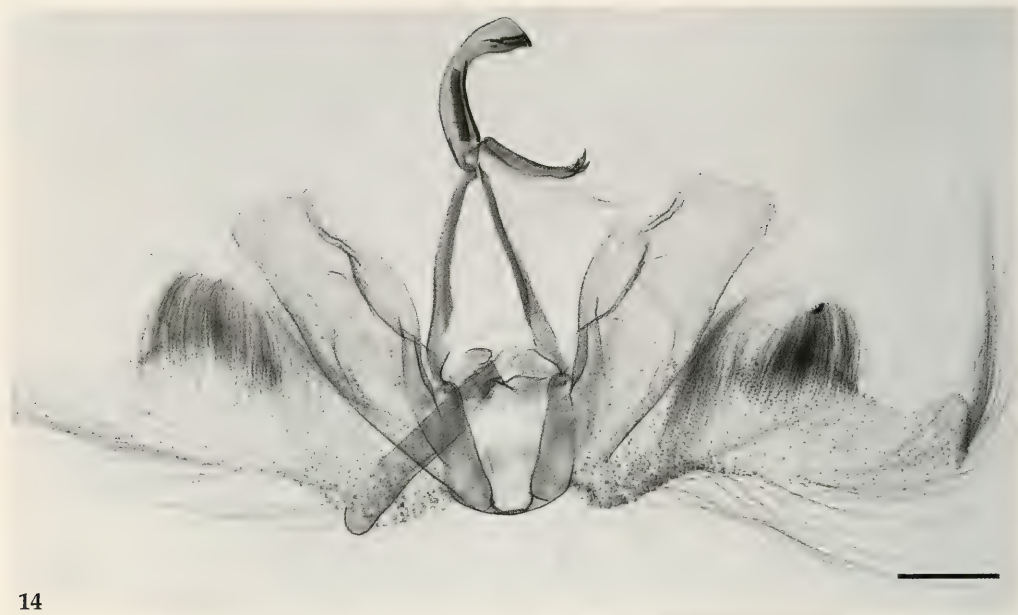
Around the uncus occur different accessory or associated structures. These structures are difficult to define and quite different from species to species. The genus *Catada* exhibits a well developed scaphium. According to Tuxen (1956) a scaphium is a sclerotization of the dorsal part of the anal tube. “Anal tube” is used here as the commonplace term. According to Kristensen (i.l.) the terminal postgenital region which bears the anus as the apical element of the alimentary canal should be referred to as the “anal cone”. This differentiation may be relevant to point out that the sclerotizations affect the postgenital wall surrounding the terminal digestive tract and not the digestive tube itself. These sclerotizations seem to have either a function in protecting the skinny sector of anal cone and anal tube (s.str.) from fine pointed terminal hooks of the unci and in keeping the uncus in a pocket-knife resting position (Lödl, in preparation). The scaphium of *Catada* represents the same interesting evolutive progression as the uncus does. The primitive state is just a corium-like dorsal surface of the anal cone with a strong terminal tooth (*C. phaeopasta*; fig. 5). The intermediate forms (*C. transversalis*, *C. antevorta*, figs 7, 15) exhibit long, strongly sclerotized, claw-like scaphia. The derived species have the claw-like



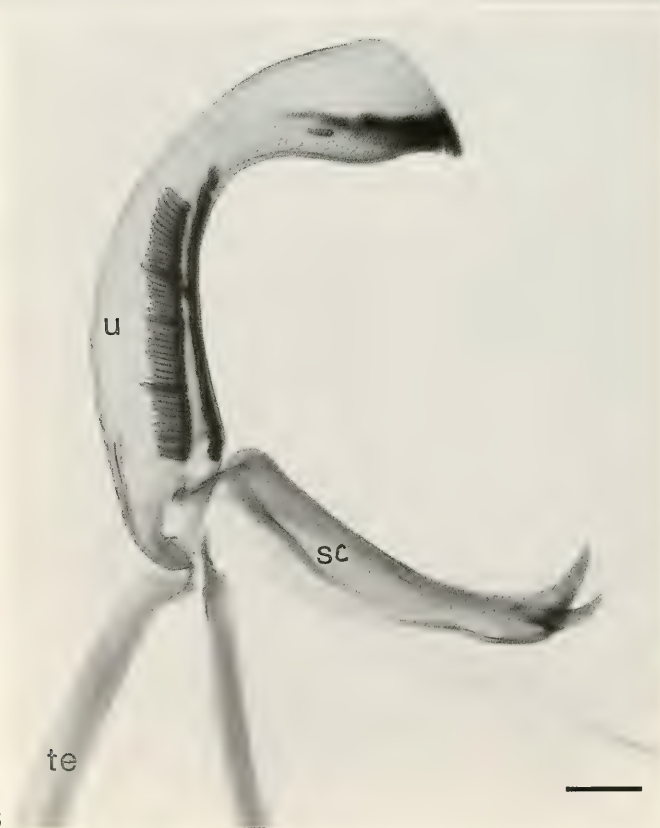
**Figs 2-7.** Plesiomorphic states of unci of *Catada* sp.; scale = 0.1 mm. **2-5.** *Catada phaeopasta* Hampson, 1909. Holotype, Noctuidae Brit. Mus. slide No. 16508. **2.** Uncus (sc scaphium; u uncus), arrow indicates primary teeth-like setae on the ventral margin of uncus. **3.** dto. – enlarged. **4.** Tip of uncus with teeth-like sclerotizations. **5.** Scaphium. **6-7.** *Catada transversalis* (Moore, 1877). Noctuidae Brit. Mus. slide No. 16503. **6.** Uncus and scaphium. **7.** Terminal end of uncus with corona of teeth.



**Figs 8-13.** Advanced uncus characters of *Catada* sp., scale = 0.1 mm. **8.** *Catada vagalis* (Walker, [1859] 1858); Noctuidae Brit. Mus. slide No. 16027. **9.** *Catada charalis* Swinhoe, 1900. Lectotype, Noctuidae Brit. Mus. slide No. 16504. **10.** *Catada obscura* Joannis, 1906. Noctuidae Brit. Mus. slide No. 16512. **11.** *Catada canaliferalis* (Moore, 1877). Noctuidae Brit. Mus. slide No. 16489. **12.** *Catada ndalla* Bethune-Baker, 1911. Noctuidae Brit. Mus. slide No. 16509. **13.** *Catada renalis* (Moore, 1882). Noctuidae Brit. Mus. slide No. 16507. Abbreviations: *sc* scaphium; *ta* tuba analis; *te* tegumen; *u* uncus.



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Figs 14-15. Male genitalia of *Catada antevorta* (Viette, 1958). Holotype, Viette prep. 3283. 14. Genitalia total, saccus coremata fully everted, aedeagus in situ. Scale = 0.5 mm. 15. Uncus-scapium-complex (*sc* scaphium; *te* tegumen, *u* uncus). Scale = 0.1 mm.

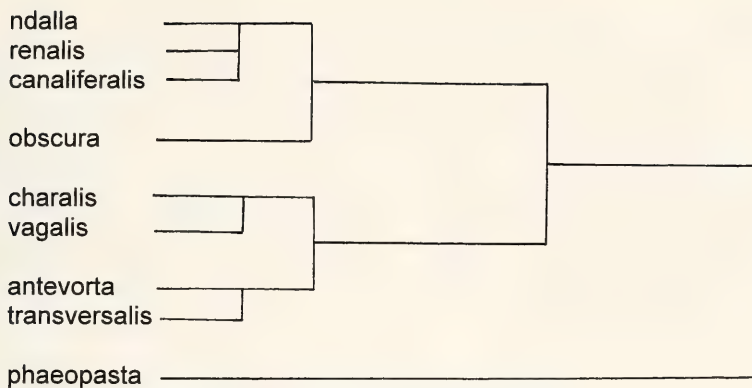


Fig. 16. Phylogeny of the species of the genus *Catada* involved in this study.

type (e.g. *C. vagalis*, figs 8-9) as well as the fork-like type (Figs 11-13). The flat, fork-like type with rounded pronges inserts with a rounded base directly at the uncus base and can wear a pair of lappets at the basal third which insert in a skinny bulbus at the articulation of tegumen and uncus. These lappets are possible insertions of the muscles 9DV1 and 9 VL1. The first is the longitudinal muscle of the 9<sup>th</sup> segment arising on the lateral edge of the tegumen and inserting on the sclerotizations around the anal cone (Eaton 1984). The latter is a ventrolongitudinal muscle of the 9<sup>th</sup> segment and arises from the sclerotized, dorsal parts of the diaphragma and also inserts at the sclerotizations around the anal cone (Eaton 1984). The middle of the “fork” shows a loop-like window in the sclerotization. This area is weaker and covered by soft tissue. The function is unclear. Form and situation of this loop are of specific value.

The cooperation between the helmet-shaped uncus of the derived *Catada*-species and the claw- or fork-like scaphia during the mating behaviour is highly speculative. A clasping mechanism is also possible as a pushing mechanism. The author assumes a clear function in controlling the uncus during the resting behaviour. This is supported by the obvious correlation of the scaphium length and the uncus length. Even the protection of the skinny anal cone in the derived species seems to be not necessary, the possession of a scaphium could be a plesiomorphic feature itself. The primitive type (*C. phaeopasta*) with long and hook-shaped uncus clearly requires a contrasting feature which is found in a knob- and teeth-covered sclerotization of the terminal region of the anal cone. The more derived species with flat and fork-like scaphia with rounded pronges could insert in the extended terminal area of the helmet-shaped uncus. A prevention of the anal tube from being pierced by a fine-pointed uncus is clearly not necessary. The corresponding features on the copulatory tract of the females are very difficult to locate. In contrast to the males, the females have quite average noctuid genitals (Lödl 1999b). The genus *Catada* is an Old World genus with a distribution from the tropical Africa to Australia. Although the distribution pattern and its evolutive development still remain unclear one can assume the origin of the primitive *Catada*-taxa in Equatorial Africa. Species with really plesiomorphic states have not been found in the Oriental and Australian region so far. *C. antevorta* and *C. transversalis* as the intermediate species occur on islands: Madagascar and the Andaman Islands.

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